

**S. S. Jain Subodh PG (Autonomous) College Rambagh  
Circle, Jaipur –302004**

**SYLLABUS**

**For**

**Bachelor of Science (B.Sc. Hon.)**

**Subject- Zoology**

**SCHEME OF EXAMINATION AND COURSES OF STUDY**



**FACULTY OF SCIENCE**

**DEPARTMENT OF ZOOLOGY**

**(Semester system, w.e.f. Academic Year 2022- 25)**

Examination Scheme

<b>Syllabus Zoology Hon. Sem. I</b>				
Nomenclature		External Theories	Internal Theories	Total Max. Marks
Paper I	Diversity of Animals-I (Lower Invertebrates)	45	30	75
Paper II	Cell Biology	45	30	75
Paper III	Developmental biology	45	30	75
Paper IV	Principles of Ecology	45	30	75
Practical		150		

<b>Syllabus Zoology Hon. Sem. II</b>				
Nomenclature		External Theories	Internal Theories	Total Max. Marks
Paper I	Diversity of Animals-II (Higher Invertebrates)	45	30	75
Paper II	Molecular Biology	45	30	75
Paper III	Principles of Genetics	45	30	75
Paper IV	Evolutionary Biology	45	30	75
Practical		150		
<b>Syllabus Zoology Hon. Sem. III</b>				

Nomenclature		External Theories	Internal Theories	Total Max. Marks
Paper I	Diversity of Animal-I (Chordates)	45	30	75
Paper II	Animal Physiology I	45	30	75
Paper III	Animal behaviour and Chronobiology	45	30	75
Paper IV	Microbiology and Parasitology	45	30	75
Practical		150		

<b>Syllabus Zoology Hon. Sem. IV</b>				
Nomenclature		External Theories	Internal Theories	Total Max. Marks
Paper I	Comparative anatomy and Biology of Vertebrates	45	30	75
Paper II	Animal Physiology II	45	30	75
Paper III	Immunology	45	30	75
Paper IV	Applied Zoology	45	30	75
Practical		150		

<b>Syllabus Zoology Hon. Sem. V</b>				
Nomenclature		External Theories	Internal Theories	Total Max. Marks
Paper I	Biochemistry	45	30	75
Paper II	Wild life conservation and management	45	30	75

Paper III	Bio techniques, Instrumentation and Bioinformatics	45	30	75
Paper IV	Apiculture	45	30	75
Practical		150		
<b>Syllabus Zoology Hon. Sem. VI</b>				
Nomenclature		External Theories	Internal Theories	Total Max. Marks
Paper I	Animal Biotechnology	45	30	75
Paper II	Environment and Public health	45	30	75
Paper III	Research methodology And Biostatistics	45	30	75
Paper IV	Medical Diagnostics, Health and Hygiene			
Practical		150		

## **B.Sc. Hon. Zoology**

### **Semester I**

#### **Paper –I: Diversity of Animals-I(lower invertebrates)**

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit 1</b>	<b>5</b>
1.General characteristics and Classification of phylum Protista, Parazoa and Metazoan up to classes 2.Study of Euglena, Amoeba and Paramecium (Locomotion and Reproduction) 3.Economic importance of phylum protozoa ,Life Cycle and Pathogenicity of Plasmodium vivax and Entamoeba histolytica	
<b>Unit 2</b>	<b>5</b>
1. Salient feature General characteristics and Classification of phylum Porifera Cnidaria and Ctenophora up to classes 2. Type study- Hydra Sycon, Canal system in sponges, Nervous system 3. Economic importance of phylum Porifera, Metagenesis in obelia, Polymorphism in Cnidaria and Coral reefs	
<b>Unit 3</b>	<b>4</b>
1. Salient features and classification of Coelenterate up to Classes 2. Type study – Obelia, Hydra 3. Polymorphism, Metagenesis, Corals and Coral Reefs	
<b>Unit 4</b>	<b>7</b>
1. Salient features and classification of Platyhelminthes and Nematelminthes up to Classes 2. Type study- Taenia and Fasciola (External features, Nervous system, reproductive system and life cycle) and pathogenicity 3. Type study Ascaris (External features ,Nervous system, reproductive system and life cycle) and pathogenicity	

#### **SUGGESTED READINGS**

- ❖ Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
- ❖ Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002).
- ❖ The Invertebrates: A New Synthesis, III Edition, Blackwell Science
- ❖ Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
- ❖ Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home

## Paper-II: Cell Biology

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit 1</b>	<b>6</b>
1. Overview of Prokaryotic and Eukaryotic cells, Virus, Mycoplasma, Prions, 2. Various models of plasma membrane structure, Diffusion, Osmosis and permeability, endocytosis and pinocytosis Transport across cell membranes: Active and Passive transport, Facilitated transport 3. Cell junctions: Tight junctions, Desmosomes, Gap junctions	
<b>Unit 2</b>	<b>8</b>
1. Structure and Functions: Endoplasmic Reticulum, Golgi apparatus, Lysosomes, 2. Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Origin of Mitochondria 3. Electron Transport system, Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis,	
<b>Unit 3</b>	<b>5</b>
1. Nuclear organization: structure of nucleus Nuclear envelope, Nuclear pore complex 2. Chromosomal organization: Types of Chromosomes, Euchromatin and Heterochromatin 3. Packaging (nucleosome)	
<b>Unit 4</b>	<b>5</b>
1. Cell division Amitosis, Mitosis and Meiosis 2. Cell cycle and its regulation: Role of Cyclin and kinase 3. Cell Signalling GPCR and Role of second messenger (cAMP)	

### SUGGESTED READINGS

- ❖ Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
- ❖ De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- ❖ Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- ❖ Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

- ❖ Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.

### **Paper III: Developmental biology**

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit 1</b>	<b>6</b>
<ol style="list-style-type: none"> <li>1. Historical perspective and basic concepts of Development Biology: Phases of development, Types of development biology</li> <li>2. Cell – cell Interaction Pattern formation, Differentiation and growth</li> <li>3. Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes, differential gene expression</li> </ol>	
<b>Unit 2</b>	<b>10</b>
<ol style="list-style-type: none"> <li>1. Fertilization, types and mechanism of fertilization, significance of fertilization, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula, Gastrulation, Fate maps (including Techniques);</li> <li>2. Parthenogenesis</li> <li>3. Early development of frog and chick up to gastrulation</li> </ol>	
<b>Unit 3</b>	<b>8</b>
<ol style="list-style-type: none"> <li>1. Fate of Germ Layers; Extra-embryonic membranes in birds;</li> <li>2. Implantation embryogenesis and gestation in human , Placenta (Structure, types and functions of placenta)</li> <li>3. In vitro fertilization, GIFT, ZIFT, Stem cell, types and use of stem cell (ESC), Amniocentesis</li> </ol>	
<b>Unit 4</b>	<b>12</b>
<ol style="list-style-type: none"> <li>1. Metamorphosis: Definition Types and Changes during Metamorphoseis, hormonal regulations in amphibians and insects;</li> <li>2. Regeneration: Definition and Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Definition Concepts and various Theories of ageing</li> <li>3. Teratogenesis: Teratogenic agents and their effects on embryonic development</li> </ol>	

#### **SUGGESTED READINGS**

- ❖ Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
- ❖ Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press
- ❖ Carlson, R. F. Patten's Foundations of Embryology
- ❖ Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
- ❖ Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

## **Paper IV:Principles of Ecology**

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit 1</b>	<b>4</b>
<ol style="list-style-type: none"> <li>1. History of ecology, Defination of ecology Types of ecology: Autecology and synecology</li> <li>2. Laws of limiting factors</li> <li>3. Study of Environmental factors: Biotic and Abiotic</li> </ol>	
<b>Unit 2</b>	<b>5</b>
<ol style="list-style-type: none"> <li>1. Population, Definition ,Types and Characteristics of Population density, natality, mortality, survivorship curves, age and ratio, sex ratio, dispersal and dispersion , affecting factors and regulation of population,Exponential and logistic growth.</li> <li>2. Population interactions, Gause’s Principle with laboratory and field examples</li> <li>3. Lotka-Volterra equation for competition and predation, functional and numerical responses</li> </ol>	
<b>Unit 3</b>	<b>4</b>
<ol style="list-style-type: none"> <li>1. Community, definition characteristics: species richness, dominance, diversity, abundance</li> <li>2. Ecotone: and edge effect; ecological succession: Types of succession(Hyoboxse and xeroxeru)</li> <li>3. Theories pertaining to climax community</li> </ol>	
<b>Unit 4</b>	<b>5</b>
<ol style="list-style-type: none"> <li>1. Ecosystem, Definition types of ecosystem with one example in detail, man-made ecosystem</li> <li>2. Food chain: detritus and grazingfood chains, Linear and Y-shaped food chains, food web, trophic levels, Energy flow through the ecosystem, Ecological pyramids</li> <li>3. Nutrient and biogeochemical cycles Nitrogen,Oxygen,water sulphur, and Phosphorus</li> </ol>	

## SUGGESTED READINGS

- ❖ Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
- ❖ Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
- ❖ Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
- ❖ Robert Leo Smith Ecology and field biology Harper and Row publisher
- ❖ Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press

## B. Sc. Hon. – Zoology

### Semester-I

### Zoology Practical – I

**Max. Practical Marks – 150**

**Internal marks – 60**

**External marks – 90 (Duration: 3 hrs)**

**Note – Out of the following experiments, 10 experiments must be done by the students in the semester (4 hrs per week).**

1. Study of whole mount of Euglena, Amoeba, Entamoeba and Paramecium, Binary fission and Conjugation in Paramecium, Hydra and Obelia colony
2. Study of Sycon (T.S. and L.S.), Hyalonema, Euplectella, Spongilla
3. Study of Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Madrepora, Beroe
4. Study of adult Fasciola hepatica, Taenia solium, **Ascaris** and their life cycles (Slides/microphotographs)
5. Study of adult Ascaris lumbricoides and its life stages (Slides/micro-photographs)
6. To submit a project report on any related topic on coral/coral reefs
  
7. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
8. Study of various stages of meiosis in grasshopper testis
9. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
10. Study of different developmental stages of Frog through permanent slides: 2 cell stage, 4 cell stage and 8 cell stage Cleavage stages, blastula (different types), gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)



11. Study of different developmental stages of Chick embryo through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
12. Project Report on Drosophila culture / chick embryo development
13. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community
14. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH of water, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO<sub>2</sub>
15. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

## **B.Sc. Hon. Zoology**

### **Semester II**

#### **Paper I: Diversity of Animals II: Higher Invertebrates**

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit 1</b>	<b>3</b>
<ol style="list-style-type: none"> <li>1. General characteristics and Classification of phylum Annelida up to classes</li> <li>2. Evolution of Coelom and Metamerism</li> <li>3. Nutrition, Excretion and Respiration in Annelida</li> </ol>	
<b>Unit 2</b>	<b>5</b>
<ol style="list-style-type: none"> <li>1. General characteristics and Classification of phylum Arthropoda up to classes</li> <li>2. Vision , Respiration,nervous system,digestive system,reproductive system in Arthropoda</li> <li>3. Metamorphosis in Insects Types of Metamorphosis, , Social life in bees and termites.</li> </ol>	
<b>Unit 3</b>	<b>5</b>
<ol style="list-style-type: none"> <li>1. General characteristics and Classification of phylum Mollusca up to classes</li> <li>2. Respiration, Excretion and nervous system in Mollusca, Torsion and detorsion in Gastropoda,</li> <li>3. Pearl formation in bivalves, Evolutionary significance of trochophore larva</li> </ol>	
<b>Unit 4</b>	<b>4</b>

1. General characteristics and Classification of phylum Echinodermata and Hemichordata up to classes
2. Water-vascular system in Echinodermata
3. Larval forms in Echinodermata, Affinities of Echinodermata with Chordates

### SUGGESTED READINGS

- ❖ Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition
- ❖ Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
- ❖ Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
- ❖ Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home

## Paper II: Molecular Biology

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit 1</b>	<b>6</b>
<ol style="list-style-type: none"> <li>1. Salient features of DNA and RNA, Watson and Crick model of DNA,</li> <li>2. DNA Replication in prokaryotes and eukaryotes</li> <li>3. Mechanism of DNA replication: Conservative, Semi-conservative, bidirectional and semi-discontinuous replication</li> </ol>	
<b>Unit 2</b>	<b>5</b>
<ol style="list-style-type: none"> <li>1. RNA polymerase and transcriptional Unit</li> <li>2. Mechanism of transcription in Prokaryotes and Eukaryotes</li> <li>3. Genetic code, Degeneracy of the genetic code and Wobble Hypothesis</li> </ol>	
<b>Unit 3</b>	<b>8</b>
<ol style="list-style-type: none"> <li>1. Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, aminoacyl tRNA synthetases and charging of tRNA</li> <li>2. Proteins synthesis in eukaryotes ; Inhibitors of protein synthesis</li> <li>3. Difference between prokaryotic and eukaryotic translation</li> </ol>	
<b>Unit 4</b>	<b>6</b>

1. Splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA
2. Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac operon and trp operon
3. Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing,

### **SUGGESTED READINGS**

- ❖ Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- ❖ Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: Molecular Biology of the Cell, IV Edition.
- ❖ Cooper G. M. and Robert E. Hausman R. E. The Cell: A Molecular Approach, V Edition, ASM Press and Sinauer Associates.
- ❖ De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- ❖ Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
- ❖ Lewin B. (2008). Gene XI, Jones and Bartlett
- ❖ McLennan A., Bates A., Turner, P. and White M. (2015). Molecular Biology IV

### **Paper III: Principles of Genetics**

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit 1</b>	<b>6</b>
1.Principles of inheritance: Mendelism, Brief history of Genetics and Mendel’s work, Mendelian Laws, their significance and current status  2.Genetic Interactions- Epistasis-dominant and recessive, co-dominance, incomplete dominance, complementary, supplementary, inhibitory, duplicate and Lethal genes 3.Sex-linked gene, sexinfluenced and sex-limited characters inheritance.,Linkage	
<b>Unit 2</b>	<b>5</b>
1. Crossing over: Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination, 2. Recombination frequency as a measure of linkage intensity 3. Hybrids and hybridization, Somatic cell hybridization.	
<b>Unit 3</b>	<b>4</b>
1. Mutation, types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each) 2. Molecular basis of mutations in relation to UV light and chemical mutagens 3. Detection of mutations: CLB methods, attached X method.	
<b>Unit 4</b>	<b>5</b>

1. Chromosomal mechanisms of sex determination in *Drosophila*, Birds and Mammals
2. Criteria for extra-chromosomal inheritance, Cytoplasmic inheritance, mitochondrial mutations in *Saccharomyces*
3. Infective heredity in *Paramecium*, Kappa particles and Maternal effects

## SUGGESTED READINGS

- ❖ Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India
- ❖ Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc
- ❖ Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings
- ❖ Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings
- ❖ Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co
- ❖ Fletcher H. and Hickey I. (2015). Genetics. IV Edition. GS, Taylor and Francis Group, New York and London

## Paper IV Evolutionary Biology

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit 1</b>	<b>4</b>
<ol style="list-style-type: none"> <li>1. Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism</li> <li>2. Evidences of Evolution: Fossil record (types of fossils, transitional forms) geological time scale, evolution of horse</li> <li>3. Theory of molecular evolution</li> </ol>	
<b>Unit 2</b>	<b>6</b>
<ol style="list-style-type: none"> <li>1. Sources of variations: Heritable variations and their role in evolution</li> <li>2. Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium.</li> <li>3. Natural selection (concept of fitness, selection coefficient, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection.)</li> </ol>	
<b>Unit 3</b>	<b>5</b>
<ol style="list-style-type: none"> <li>1. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon) Role of Migration and Mutation in changing allele frequencies</li> </ol>	

2. Product of evolution: inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation
3. Adaptive radiation / macroevolution

#### **Unit 4**

**5**

1. Origin and evolution of man, Unique hominin characteristics contrasted with primate characteristics,
2. Primate phylogeny from Dryopithecus leading to Homo sapiens,
3. Phylogenetic trees, Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees

#### **SUGGESTED READINGS**

- ❖ Ridley, M (2004) Evolution III Edition Blackwell publishing
- ❖ Hall, B.K. and Hallgrimson, B (2008). Evolution IV Edition. Jones and Barlett Publishers.
- ❖ Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
- ❖ Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
- ❖ Snustad, S Principles of Genetics.
- ❖ Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition WileyBlackwell
- ❖ Minkoff, E. (1983). Evolutionary Biology. Addison-Wesl

### **B. Sc. Hon. – Zoology**

#### **Semester-II**

#### **Zoology Practical – II**

**Max. Practical Marks – 150**

**Internal marks – 60**

**External marks – 90 (Duration: 3 hrs)**

**Note: out of the following 8 Experiments must be done by the students in this semester**

**Practical (4 hr per week)**

1. Study of following specimens:

Annelids – Pheretima Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria

Arthropods - Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Termites and honey bees

Molluscs - Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus

Echinodermates -Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and Antedon

2. Study of Polytene chromosomes from Chironomous / Drosophila larvae
3. Preparation of Liquid culture medium and solid culture medium for growth of microorganisms
4. Demonstration of antibiotic sensitivity using E.coli( any bacteria) as a model.
5. To study the Mendelian laws and gene interactions.
6. Linkage maps based on data from conjugation, transformation and transduction.
7. Study of PCR
8. Extraction of Genomic DNA
9. Study of fossils from models/ pictures
10. Study of homology and analogy from suitable specimens
11. Darwin's Finches with diagrams/ cut outs of beaks of different species

## **B.Sc. Hon. Zoology**

### **Semester III**

#### **Paper I: Diversity of Animals-I (Chordates)**

Theory	Credit Hrs
<b>Unit 1</b>	<b>5</b>
1. Origin ,general characteristics and outline classification of Chordates	
2. Protochordate :General Features, Phylogeny of Protochordata	
3. General features of Agnatha and classification of cyclostomes up to classes	
<b>Unit 2</b>	<b>8</b>
1. General characters,Origin and evolution of Fishes and Amphibia:, general characters and classification up to order	
2. Osmoregulation in Fishes, Types of scales and fins, Migration	
3. Parental care and neoteny in Amphibia.	
<b>Unit 3</b>	<b>3</b>
1. General features and Classification of Reptiles up to orders	
2. Poisonous and non-poisonous snakes	

3. Biting mechanism in snakes

#### **Unit 4**

**4**

1. General characters and classification of Aves up to orders, origin of birds flight adaptations in birds, types of Feathers, Perching mechanism,
2. Origin General characters and classification of mammals up to orders
3. Adaptive radiation, Volant and aquatic adaptation in mammals

### **SUGGESTED READINGS**

- ❖ Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
- ❖ Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
- ❖ Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills
- ❖ Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons.
- ❖ Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.
- ❖ Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
- ❖ Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.

## **Paper II: Animal Physiology I**

Theory

Credit Hrs

#### **Unit 1**

**5**

1. Structure and function of digestive glands
2. Digestion and absorption of carbohydrates, fats and proteins
3. Nervous and hormonal control of digestion (in brief)

#### **Unit 2.Circulation**

**10**

1. Body Fluid: Composition and functions of blood; Lymph composition & function; Blood Pressure, Regulation of Blood Pressure
2. Blood clotting – Intrinsic and extrinsic factors, Blood: composition and constituents Blood groups and Rh factor
3. Physiology of cardiac muscles, structure & function of heart; Human Cardiac Cycle; Cardiac Origin of Heart Beat; Regulation of Heart Beat, Elementary idea of Haemostasis, ECG, factors contributing to heart problems; Angioplasty; Angiograph

#### **Unit 3 Respiration**

**5**

1. Ventilation, External and internal Respiration
2. Transport of oxygen and carbon dioxide in blood, Factors affecting transport of gases.
3. Disease related to Respiration

#### **Unit 4 Excretion**

**8**

1. Types of Nitrogenous waste products (Ammonotelic, Uricotelic, Ureotelic)
2. Structure and function of kidney; Nephron; Renal blood supply, Mechanism of Urine formation in mammals
3. Hormonal control of renal function; Renin- Angiotensin System, Micturition, Regulation of Body Fluids & Acid Base balance

#### **SUGGESTED BOOKS**

- ❖ Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Harcourt Asia PTE Ltd. /W.B. Saunders Company.
- ❖ Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
- ❖ Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
- ❖ Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.

### **Paper III: Animal behaviour and Chronobiology**

#### **Theory**

#### **Credit Hrs**

#### **Unit 1**

**5**

1. Definition and general mechanism of animal behaviour
2. Major contribution of scientists (Karl Von Frish, Irvan Pavlov, Konrad Lorenz, Niko Tinbergen.)



3. Individual Behavioural patterns; Instinct vs. Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting.

### **Unit2**

**10**

1. Learning and Memory: Classification or forms of learning and memory, motivation and behaviour
2. Structure of Brain, Methods of studying Brain Behaviour: Neurotransmitter, Physiological and Neurochemical Technique,
3. Control of behaviour: Neural control, Hormonal control, Elementary idea of role of Pheromones,

### **Unit 3**

**6**

1. Communication and the senses; Altruism; Insects
2. Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.
3. Social Behaviour: Concept of Society with Honey bee as example, Foraging in honey bee and advantages of the waggle and round dance.

### **Unit 4**

**4**

1. Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and lunar rhythms.
2. Adaptive significance of biological clocks
3. Circannual rhythms; Photoperiod and regulation seasonal reproduction of vertebrates; Role of melatonin.

## **SUGGESTED READINGS**

- ❖ David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.
- ❖ Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour, Cambridge, University Press, UK.
- ❖ John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
- ❖ Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
- ❖ Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA

## **Paper IV: Microbiology and Parasitology**

### **Theory**

### **Credit Hrs**

#### **Unit –I**

**5**

1. History and scope of Microbiology: Characterization, Basic Classification and identification of Microorganisms.
2. Working of A.V. Leeuwenhock, Louis Pasteur, Robert Koch and Germ PlasmTheory of diseases.

3. World of Microbes: General Morphology of Protozoa, bacteria and fungi – Molds and Yeasts

#### **Unit –II**

**5**

1. Morphology of Bacteria; Difference between Gram-positive and Gram-negative Bacteria
2. Growth & nutrition: Microbial Nutrition, Growth and Control: Nutritional requirements (macro & micronutrients), Factors affecting growth of bacterial culture
3. Basic idea of Culture: Types of culture media, uptake of nutrients, Maintenance of pure cultures, Growth & Reproduction: Bacterial division, growth curve, generation time, measurement of growth. Asepsis, sterilization with physical and chemical agents; Reproduction in bacteria- Asexual and sexual

#### **Unit-III**

**6**

1. Virus: Structure, Classification; Life Cycle- Lytic and Lysogenic; A Bacteriophage
2. AIDS & Hepatitis: Epidemiology, prevention, control and treatment
3. Applied Microbiology: Fermented Food production (Dairy Products, Alcoholic Beverages); Microbial spoilage and techniques of Food Preservation

#### **Unit-IV**

**8**

1. Parasitic Protozoans: life cycle, pathogenesis and disease caused by Entamoeba; Plasmodium, Trypanosoma
2. Parasitic Helminths: life cycle, pathogenesis and disease caused by Liver fluke, and Ascaris lumbricoides
3. Antibiotics and other chemotherapeutic agents

### **SUGGESTED READINGS**

- ❖ Mani,A., Selvaraj, A.M., Narayanan, L.M. &Arumugam, N. 1996 : Microbiology – saras publications – Nagercoil-India.
- ❖ Sharma, P.D. 1998: Microbiology – Rastogi Publ. Meerut, India
- ❖ Subba Rao, N.S., 1999: Soil Microbiology, Oxford IBH Co. New Delhi, India.
- ❖ Sullia,S.B. &Santharam,S. 2004-General Microbiology, Oxford IBH, India.
- ❖ Meenakumari, S. Microbial Physiology, MJP-Publ.-Chennai, India.
- ❖ Purushotam Kaushik, 2005: Microbiology –S.Chand& Co. New Delhi, India
- ❖ Vijaya Ramesh, 2005: Environmental Microbiology, MJP.Publ., Chennai, India
- ❖ Vijaya Ramesh, 2007: Food Microbiology, MJP.Publ. Chennai, India.
- ❖ Rajan,S. 2007: Medical Microbiology – MJP.Publ. Chennai, India.
- ❖ Purohit, S.S. 2007: Microbiology - Agrobios Publ. India
- ❖ Trivedi, P.C.2008: Applied Microbiology - Agrobios Publ. India
- ❖ Burton J Bogitsh Human Parasitology 3rd edition Elsevier.
- ❖ Roberts, L. S. and J. Janovy, Jr. 2004. Foundations of Parasitology. 7th Edition. McGraw Hill, Boston.
- ❖ Smith. Animal Parasitology 1996. Cambridge University Press.
- ❖ Marr et al. Molecular Medical Parasitology 2003, Elsevier.

- ❖ Lawrence R. Ash and Thomas C. Orihel. Atlas of Human Parasitology. American Society for clinical pathology press 5th edition, 2007.
- ❖ Janet Amundson Romich. Understanding Zoonotic Diseases. 2007

**B. Sc. Hon. – Zoology**  
**Semester-III**  
**Zoology Practical – III**

**Max. Practical Marks – 150**

**Internal marks – 60**

**External marks – 90 (Duration: 3 hrs)**

**Note: out of the following experiments 8 Experiment must be done by the students in this semester**

**1. Study of Specimen.**

- A) Protochordata: Herdmania, Ciona, Salpa, Doliolum, Amphioxus
- B) Lower Chordates: Petromyzon, Myxine/Bdellostoma, Ammocete larva,
- C) Pisces: Sphyrna, Trygon (Sting ray), Pristis( Saw Fish), Raja (Skate), Torpedo, Chimaera (Rat Fish), Acipensor, Labeo, Clarius, Anguilla (eel), Exocoetus, Hippocampus,
- D) Amphibia: Ichthyophis, Ambyostoma (Tiger Salamander), Axolotl Larva, Salamandra, Proteus, Siren, Alytes, Pipa, Hyla, Rhacophorous (Flying Frog)

**2. Study of Slides.**

- a) Tadpole larva of Herdmania, Herdmania Spicules, T.S. of Amphioxus
- b) V.S. of Skin of Scoliodon, Amphibia

**3. Mounting.**

- a) Herdmania Spicules, Placiod Scale

**4. Dissection: [Through demonstration by chart/ CAL/ Video]**

Major: Afferent, Efferent branchial vessels; Cranial nerves of Scoliodon.

Minor: Internal Ear; Eye Muscles; Ampulla of Lorenzini

4. Enumeration of red blood cells and white blood cells using haemocytometer
5. Estimation of haemoglobin using Sahli's haemoglobinometer
6. To study nests and nesting habits of the birds and social insects.
7. To study the behavioural responses of wood lice to dry and humid conditions.
8. To study geotaxis behaviour in earthworm.
9. Preparation and use of culture media for microbes
10. Staining procedure for parasites
11. Identification of Protozoan parasites from permanent slides.
12. Trypanosoma (epimastigote or trypomastigote form); Leishmania (promastigote and amastigote form); Plasmodium (sporozoites and signet ring)
13. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.

## **B.Sc. Hon. Zoology**

### **Semester IV**

#### **Paper I: Comparative Anatomy and Biology of Vertebrates**

Theory	Credit Hrs
<b>Unit- 1</b>	<b>7</b>
Comparative anatomy of the following organ systems of Scoliodon, Rana, Uromastix / Varanus, Collumba and Oryctolagus:	
<ol style="list-style-type: none"> <li>1. Integument and its derivatives.</li> <li>2. Alimentary canal and accessory digestive glands.</li> <li>3. Respiratory organs.</li> </ol>	<b>8</b>
<b>Unit-2</b>	<b>8</b>
<ol style="list-style-type: none"> <li>1. Heart, aortic arches and their evolution.</li> <li>2. Brain and cranial nerves,</li> <li>3. Urogenital system (Pro, Meso and Metanephric kidney and genital ducts in males and females).</li> </ol>	
<b>Unit-3</b>	<b>8</b>
<ol style="list-style-type: none"> <li>1. Osteology: Skull, Axial and appendicular skeleton Girdles, limb bones, Vertebrae, ribs and sternum; jaw suspension, Structure and types of vertebrae</li> <li>2. Sense Organ: Comparative anatomy of eye</li> <li>3. Sense Organ: Classification of receptors, Mechanism of sound production</li> </ol>	
<b>Unit-4</b>	<b>7</b>
<ol style="list-style-type: none"> <li>1. Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory</li> <li>2. Distribution of vertebrates in different realms</li> </ol>	

### 3. Dentition, Adaptive radiation In Mammals

#### **SUGGESTED READINGS**

- ❖ Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
- ❖ Pough H. Vertebrate life, VIII Edition, Pearson International.
- ❖ Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.
- ❖ Hall B.K. and Hallgrímsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc

## **Paper II: ANIMAL PHYSIOLOGY II**

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit 1: Muscle Physiology</b>	<b>8</b>
1. Muscles: Ultra structure of striated muscle, Physiology of Muscle Contraction; sliding filament theory of muscle contraction; Neuromuscular Junction	
2. Muscles: Properties of muscles (Twitch, Tetanus & Rigor mortis, Tonus, Summation, All or None Principle, Muscle fatigue, muscle dystrophies)	
3. Elementary idea of Sports Physiology	
<b>Unit-2 Nerve Physiology</b>	<b>8</b>
1. Nerves: Types of neurons, E.M. structure of neuron; Myelinated and non-myelinated nerve fibres	
2. Nerves: Resting and action potential; Conduction of nerve impulse; Types of synapses, Reflex Arc and Reflex Action	
3. Signal Transmission at synapses, Neurotransmitters- Small molecule and Neuropeptide Neurotransmitters	
<b>Unit-3 Reproductive physiology</b>	<b>6</b>
1. Oestrous and menstrual cycle, Male and female reproductive organs Male and female sex hormones, Causes of infertility in male and female	
2. General mechanism of hormone action: Peptide hormone; Steroid hormone	
3. Neurohypophysial hormones – Oxytocin and Vasopressin, Hormones of the Adenohypophysis; Hypothalamic control of Adenohypophysis; Dwarfism; Acromegali	
<b>Unit-4 Sensory Physiology</b>	<b>6</b>
1. Structure of human eye; image formation and colour vision	
2. Structure of human ear, mechanism of hearing	

3. Elementary idea of EEG, MRI, CT-scan, mental health (epilepsy, neurosis, psychosis)

#### SUGGESTED READINGS

- ❖ Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley and Sons, Inc.
- ❖ Widmaier, E.P., Raff, H. and Strang, K.T. (2008). Vander's Human Physiology, XI Edition, McGraw Hill.
- ❖ Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
- ❖ Marieb, E. (1998). Human Anatomy and Physiology, IV Edition, Addison-Wesley.

### **Paper III: Immunology**

#### **Theory**

#### **Credit Hrs**

#### **Unit 1**

2

1. Historical perspective of Immunology, Early theories of Immunology
2. Cells and organs of the Immune system
3. Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), passive: Acquired and natural Immunity, Active: Acquired and natural Immunity.

#### **Unit 2**

3

1. Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity,
2. B and T-Cell
3. Antigen-antibody interactions

#### **Unit 3**

5

1. Structure and functions of different classes of immunoglobulin's, Immunoassays (ELISA and RIA),
2. Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis,
3. Major Histocompatibility Complex

#### **Unit 4**

4

1. Complement System, Interferons
2. Basic Idea of Auto Immune Diseases
3. Various types of vaccines

#### SUGGESTED READINGS

- ❖ Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.

- ❖ David, M., Jonathan, B., David, R. B. and Ivan R. (2006). Immunology, VII Edition, Mosby, Elsevier Publication.
- ❖ Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Public

## **Paper IV: Applied zoology**

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit 1: Introduction to Host-parasite Relationship</b>	<b>5</b>
<ol style="list-style-type: none"> <li>1. Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis</li> <li>2. Sericulture: Types of Silkworm. Life cycle and rearing of Bombyxmori; Brief idea of cocoon processing for silk fabric cocoon boiling, reeling, reeling, winding, doubling, twisting and weaving</li> <li>3. Lac culture – Lac insect, Lacciferlacca - Life cycle, Lac processing, Lac products and Economic Importance</li> </ol>	
<b>Unit-II: Economic Entomology</b>	<b>7</b>
<ol style="list-style-type: none"> <li>1. Chemical control of Insecticides: Pyrethroids, Carbonate and HCN (mode of action, merits and demerits)</li> <li>2. Biological control of Pests: Biological agents (predators and parasites; merits and demerits) Crop pest: Life cycle, damage and control of Cotton spotted boll worm – Eariasvitella Stored grain pest- Rice Weevil, Sitophilusoryzae</li> <li>3. Animal pest: Life cycle, damage and control of House fly – Musca nebulo, Stable fly – Stomoxyscalcitran</li> </ol>	
<b>Unit III: Economics of aquaculture</b>	<b>8</b>
<ol style="list-style-type: none"> <li>1. Pisciculture – Techniques of induced breeding; Edible Fishes; By Products of Fishing and its commercial values</li> <li>2. Prawn culture -Culture techniques of fresh water Prawn (Macrobrachiumrosebergii) &amp; Marine water Prawn (Penaeusmonodon)</li> <li>3. Pearl culture: Formation and nature of Pearls – Commercial importance of Pearl Culture in India.</li> </ol>	
<b>Unit IV: Economic importance of other animals</b>	<b>8</b>
<ol style="list-style-type: none"> <li>1. Vector borne diseases : Abrief account of insect vectors affecting the health of man and domestic animals.</li> <li>2. Animal husbandry: Introduction to common dairy animals; Techniques of dairy management, , Future strategies for Livestock Development: Transgenic Animal</li> </ol>	

Technology; Genetic improvement for best breeds; Economic importance of Dairy, Leather, Wool, Fur

3. Vermiculture: Vermitechnology, Bio-Fertilizers

### **SUGGESTED READINGS**

- ❖ Kumar and Corton. Pathological Basis of Diseases.
- ❖ Atwal, A.S. (1986). Agricultural Pests of India and South East Asia, Kalyani Publishers.
- ❖ Dennis, H. (2009). Agricultural Entomology. Timber Press (OR).

## **B. Sc. Hon. – Zoology**

### **Semester-IV**

### **Zoology Practical – IV**

**Max. Practical Marks – 150**

**Internal marks – 60**

**External marks – 90 (Duration: 3 hrs)**

**Note: out of the following experiments 8, Experiment must be done by the students in this semester(4Hr/Week)**

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Study of skeleton of Frog, Varanus, Fowl, Rabbit
3. Audio visual dissection of Rat/ Frog to study various system
4. Histological study of spleen, thymus and lymph nodes through slides/ photographs
5. Preparation of stained blood film to study various types of blood cells.
6. Demonstration of a. ELISA b. Immunoelectrophoresis
7. Study of Plasmodium vivax, Entamoebahistolytica, Trypanosomagambiense, Ancylostomaduodenale and Wuchereriabancrofti and their life stages through permanent slides/photomicrographs or specimens.
8. Study of arthropod vectors associated with human diseases: Pediculus, Culex, Anopheles, Aedes and Xenopsylla.
9. Visit to poultry farm or animal breeding centre. Submission of visit report
10. Maintenance of freshwater aquarium



**B.Sc. Hon. Zoology**  
**Semester V**  
**Paper I: Fundamentals of Biochemistry**

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit 1</b>	<b>4</b>
1. Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides.	
2. Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids	
3. Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Denaturation.	
<b>Unit 2</b>	<b>4</b>
1. Amino acids: Structure, Classification	
2. General Properties of Amino Acids	
3. Physiological importance of essential and non-essential amino acids	
<b>Unit 3</b>	<b>5</b>
1. Structure: Purines and pyrimidine's, Nucleosides, Nucleotides	
2. Nucleic acids Cot Curves: Base pairing, Denaturation of DNA	
3. Types of DNA and RNA, Complementarity of DNA,	
<b>Unit 4</b>	<b>8</b>
1. Nomenclature and classification of Enzymes; Cofactors; Specificity of enzyme action; Isozymes;	
2. Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalysed reactions; Regulation of enzyme action.	
3. Derivation of Michaelis- Menten equation, Concept of Km and Vmax, Line weaver-Burk plot; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics.	

**SUGGESTED READING**

- ❖ Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.

- ❖ Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
- ❖ Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.
- ❖ Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd., U.K.

## **Paper II: Wildlife Conservation and Management**

Theory	Credit Hrs
<b>Unit 1</b>	<b>3</b>
<ol style="list-style-type: none"> <li>1. Values of wild life - positive and negative</li> <li>2. Conservation ethics; Importance of conservation; Causes of depletion, World conservation strategies.</li> <li>3. IUCN, Red Data Book, WII, ZSI, WWF, BNHS</li> </ol>	
<b>Unit 2</b>	<b>4</b>
<ol style="list-style-type: none"> <li>1. Habitat analysis, Physical parameters: Topography, Geology, Soil and water</li> <li>2. Biological Parameters: food, cover, forage, browse and cover estimation;</li> <li>3. Standard evaluation procedures: remote sensing and GIS.</li> </ol>	
<b>Unit 3</b>	<b>8</b>
<ol style="list-style-type: none"> <li>1. Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity.</li> <li>2. National parks &amp; sanctuaries, Community reserve; important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve</li> <li>3. Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence, Bio- telemetry;</li> </ol>	
<b>Unit 4</b>	<b>8</b>
<ol style="list-style-type: none"> <li>1. Biodiversity and its conservation; Major Biomes, Hop spots, Hot spots of biodiversity in India, Biosphere Reserves of India</li> <li>2. Ex situ and In situ Conservation; Alpha, Beta and Gama Diversity; Causes of reduction of Biodiversity</li> <li>3. Wildlife conservation acts (1972 and 1984), Forest Conservation Act 1980, Environment (Protection) Act 1986</li> </ol>	

### **SUGGESTED READINGS**

- ❖ Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.

- ❖ Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Coexistence? Cambridge University.
- ❖ Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5<sup>th</sup> edition. The Wildlife Society, Allen Press.
- ❖ Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
- ❖ Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.

### **Paper III Bio techniques, Instrumentation and Bioinformatics**

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit –I: Principles and application of Bio techniques</b>	<b>8</b>
1. Concepts of sterilization: Filtration, autoclaving, dry heat sterilization, wet sterilization and radiation	
2. Separation of biomolecules: Centrifugation (Sedimentation, density gradient); Chromatography (Elementary idea of Paper – ascending and Circular, thin layer, gel filtration and ion exchange- Principles and applications)	
3. Electrophoresis: Agarose Gel Electrophoresis, SDS-PAGE	
<b>Unit-II: Micro Technique</b>	<b>8</b>
1. Fixation, dehydration, clearing, embedding & section cutting	
2. Difficulties encountered during section cutting (causes and remedies)	
3. Double staining with Haematoxylin and Eosin	
<b>Unit-III: Instrumentation</b>	<b>5</b>
1. Microscope: Principle of Microscopy and types	
2. Principles of colorimeter and pH meter	
3. Principles of spectrophotometers	
<b>Unit-IV: Bioinformatics</b>	<b>9</b>
1. Bioinformatics: Definition, Scope, Basic concepts in bioinformatics, importance and role of bioinformatics in life sciences	
2. Bioinformatics databases- introduction, types of databases, Nucleotide sequence databases, Elementary idea of protein databases	
3. BLASTA, FASTA, PHYLOGENY TREE Analysis	

#### **SUGGESTED READING**

- ❖ Animal Tissue Technique – Humason
- ❖ Histological Technique – Devaenport
- ❖ Microtechnique – Jiwaji&Patki
- ❖ Microtechnique – Wankhede

- ❖ Biophysical Chemistry – Upadhyay, Upadhyay and Nath
- ❖ Techniques in Life Sciences – D. B. Tembhare Bioinformatics
- ❖ Mount W. 2004. Bioinformatics and Sequence Genome Analysis 2nd Edition CBS Pub. New Delhi.
- ❖ Bergman, N. H. Comparative Genomics. Humana Press Inc. Part of Springer Science+BusinessMedia, 2007.
- ❖ Baxevanis, A. D. Ouellate, B. F. F. 2009. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. John-Wiley and Sons Publications, New York.
- ❖ Campbell A. M. and Heyer, L. J. 2007. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings

### Skill Enhancement Course I

## Paper IV Apiculture

Theory	Credit Hr
<b>Unit 1: Biology of Bees</b>	<b>4</b>
<ol style="list-style-type: none"> <li>1. History, Classification and Biology of Honey Bees</li> <li>2. Life cycle and culture</li> <li>3. Social Organization of Bee Colony</li> </ol>	
<b>Unit 2: Rearing of Bees</b>	<b>10</b>
<ol style="list-style-type: none"> <li>1. Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth Bee Pasturage Selection of Bee Species for Apiculture</li> <li>2. Bee Keeping Equipment</li> <li>3. Methods of Extraction of Honey (Indigenous and Modern)</li> </ol>	
<b>Unit 3: Diseases and Enemies</b>	<b>5</b>
<ol style="list-style-type: none"> <li>1. Bee Diseases and Enemies</li> <li>2. Control and Preventive measures</li> <li>3. Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc</li> </ol>	
<b>Unit 4: Entrepreneurship in Apiculture</b>	<b>4</b>
<ol style="list-style-type: none"> <li>1. Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens</li> <li>2. Bee product and its economic importance</li> </ol>	

### SUGGESTED READINGS

- ❖ Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
- ❖ Bisht D.S., Apiculture, ICAR Publication.
- ❖ Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delh

**B. Sc. Hon. – Zoology**  
**Semester-V**  
**Zoology Practical – V**

**Max. Practical Marks – 150**

**Internal marks – 60**

**External marks – 90 (Duration: 3 hrs)**

**Note: out of the following experiments 8, Experiment must be done by the students in this semester**

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
2. Paper chromatography of amino acids.
3. Action of salivary amylase under optimum conditions.
4. Effect of pH, temperature and inhibitors on the action of salivary amylase.
5. Demonstration of proteins separation by SDS-PAGE
6. Demonstration of different types of Microscopes
7. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna
8. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
9. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.
10. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)
11. Identification of different species of Honey Bee
12. Demonstration of different body parts of Honey Bee
13. Fifteen Days Training programme for learning various methods related to Apiculture

**B.Sc. Hon. Zoology**  
**Semester VI**  
**Paper I Animal Biotechnology**

Theory	Credit Hrs
<b>Unit 1:</b>	<b>10</b>
1. Concept and scope of biotechnology	
2. Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC	
3. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization Southern, Northern and Western blotting; DNA sequencing: Sanger method Polymerase Chain Reaction, DNA Finger Printing	
<b>Unit 2</b>	<b>8</b>
1. Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection	
2. Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knockout mice.	
3. Biotechnology in Medicine and health: Antibiotics, Enzymes, Vitamins, Steroids, Artificial Blood,	
<b>Unit 3</b>	<b>10</b>
1. Animal cell culture, expressing cloned genes in mammalian cells,	
2. Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia)	
3. Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy	
<b>Unit 4</b>	<b>5</b>
1. Environmental biotechnology: Bioconversions, microbial enhancement of oil recovery, pollution control	
2. Microbial mining and metal recovery, sewage treatment	
3. Introductory knowledge of biosensors, biochips	

**SUGGESTED READINGS**

- ❖ Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis. II Edition, Academic Press, California, USA.
- ❖ Glick, B.R. and Pasternak, J.J. (2009). Molecular Biotechnology - Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA.

- ❖ Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA.
- ❖ Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. V Edition, John Wiley and Sons Inc.
- ❖ Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNAGenes and Genomes- A Short Course. III Edition, Freeman and Co., N.Y., USA.
- ❖ Beauchamp, T.I. and Childress, J.F. (2008). Principles of Biomedical Ethics. VI Edition, Oxford University Press.

## Paper II:Environment and Public Health

Theory

Credit Hrs

### UNIT I

6

1. Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment
2. Greenhouse gases and global warming, Acid rain, Ozone layer destruction
3. Effect of climate change on public health

### Unit II

10

1. Air, water, noise and soil pollution sources and effects
2. Pollution control ,Water (Prevention and Control of Pollution) Act 1974;Air (Prevention and Control of Pollution) Act 1981; Bio-Medical Waste (Management & Handling) Rules, 1998; Transboundary Movement Rules, 2008. Hazardous waste handling Rule, NGT.
3. Radiation pollution; Movements related to Environment – Sacred groves, Bishnoi tradition, Chipko movement, Tehri dam, Sardar Sarovar, Narmada dam, Almatti dam, Silent Valley. Role of NGOs

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### Unit III

8

1. Sources of waste, types and characteristics, Sewage disposal and its management
2. Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants
3. Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.

### Unit IV

7

1. Causes, symptoms and control of Asthma, Cholera, typhoid
2. Toxic effect of heavy metals (lead, cadmium and mercury, Arsenic)
3. Brief idea about Environmental Impact Assessment

### SUGGESTED BOOKS

- ❖ Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
- ❖ Kolluru Rao, Bartell Steven, Pitblado R and Stricoff —Risk Assessment and Management Handbookl, McGraw Hill Inc., New York, 1996.
- ❖ Kofi Asante Duah —Risk Assessment in Environmental managementl, John Wiley and sons, Singapore, 1998.
- ❖ Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.



- ❖ Joseph F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey 1997

### **Paper III Research methodology And Biostatistics**

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit 1</b>	<b>5</b>
<ol style="list-style-type: none"> <li>1. Meaning, Objectives, Motivation: Research Methods vs Methodology,</li> <li>2. Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied</li> <li>3. Need for research design: Features of good design, important concepts related to good design, Observation and Facts, Prediction and Explanation, Development of Models.</li> </ol>	
<b>Unit II</b>	<b>12</b>
<ol style="list-style-type: none"> <li>1. Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies</li> <li>2. Concept of research articles, research papers, reviews, scientific popular articles, technical reports and Thesis writing, Preparation of Tables and Bibliography</li> <li>3. Ethical Issues, Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement</li> </ol>	
<b>UNIT III</b>	<b>7</b>
<ol style="list-style-type: none"> <li>1. Biostatistics : Definition and Scope, Census and sampling methods</li> <li>2. Collection and Tabular Presentation of Data: Tabulation of data; Frequency Distribution Table; Continuous and Discontinuous Series</li> <li>3. Graphical Presentation of Data: Bar, Histogram, Line graph, Polygon, Pie Diagrams</li> </ol>	
<b>UNIT IV</b>	<b>7</b>
<ol style="list-style-type: none"> <li>1. Measures of Central tendency: mean, median mode</li> <li>2. Measures of Dispersion, Mean deviation &amp; Standard deviation, Standard error.</li> <li>3. Co-efficient of Variance, Chi-square test, Z test, t-Test, Probability</li> </ol>	

#### **SUGGESTED READINGS**

- ❖ Anthony, M, Graziano, A.M. and Raulin, M.L. 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
- ❖ Walliman, N. 2011. Research Methods- The Basics. Taylor and Francis, London, New York.
- ❖ Wadhwa, B.L.: Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, 2002, Universal Law publishing
- ❖ C.R.Kothari: Research Methodology, New Age International, 2009
- ❖ Coley, S.M. and Scheinberg, C.A. 1990, —Proposal writing. Stage Publications
- ❖ Ghosh Z and Mallick B. (2008). Bioinformatics: Principles and Applications, Oxford University Press.

- ❖ Pevsner J. (2009). *Bioinformatics and Functional Genomics*, II Edition, Wiley Blackwell.
- ❖ Zvelebil, Marketa and Baum O. Jeremy (2008). *Understanding Bioinformatics*, Garland Science, Taylor and Francis Group, USA.
- ❖ Zar, Jerrold H. (1999). *Biostatistical Analysis*, IV Edition, Pearson Education Inc and Dorling Kindersley Publishing Inc. USA
- ❖ Antonisamy, B., Christopher S. and Samuel, P. P. (2010). *Biostatistics: Principles and Practice*. Tata McGraw Hill Education Private Limited, India.
- ❖ Pagana, M. and Gavreau, K. (2000). *Principles of Biostatistics*, Duxberry Press, USA

## Skill Enhancement Course II

### Paper IV Medical Diagnostics, Health and Hygiene

<b>Theory</b>	<b>Credit Hrs</b>
<b>Unit I</b>	<b>10</b>
<ol style="list-style-type: none"><li>1. Introduction to Medical Diagnostics and its Importance</li><li>2. Diagnostics Methods Used for Analysis of Blood, blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.)</li><li>3. Diagnostic Methods Used for Urine Analysis,Urine Analysis: Physical characteristics; Abnormal constituents</li></ol>	
<b>Unit II</b>	<b>8</b>
<ol style="list-style-type: none"><li>1. Non-infectious Diseases, Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit</li><li>2. Infectious Diseases Causes, types, symptoms, diagnosis and prevention of HIV, STD and Tuberculosis and Hepatitis</li><li>3. Epidemic, Endemic and Pandemic Disease: Covid -19,</li></ol>	
<b>Unit III</b>	<b>9</b>
<ol style="list-style-type: none"><li>1. Significance of Public health and Hygiene, Nutrition and health, classification of foods</li><li>2. Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders</li><li>3. Different types of communicable diseases and their control measures – TB, Measles, Cholera, Leprosy</li></ol>	
<b>Unit IV</b>	<b>8</b>
<ol style="list-style-type: none"><li>1. Tumours, Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT scan (using photographs).</li><li>2. Smoking, alcoholism, drug dependence disease</li><li>3. Obesity and Mental ill-health - their causes and prevention through dietary and lifestyle modifications,Environmental Pollution and associated health hazard.</li></ol>	

### SUGGESTED READINGS

- ❖ Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
- ❖ Godkar P.B. and Godkar D.P. Textbook of Medical Laboratory Technology, II Edition, Bhalani Publishing House

- ❖ Cheesbrough M., A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses
- ❖ Guyton A.C. and Hall J.E. Textbook of Medical Physiology, Saunders
- ❖ Robbins and Cortan, Pathologic Basis of Disease, VIII Edition, Saunders
- ❖ Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd

**B. Sc. Hon. – Zoology**  
**Semester-VI**  
**Zoology Practical – VI**

**Max. Practical Marks – 150**

**Internal marks – 60**

**External marks – 90 (Duration: 3 hrs)**

**Note: out of the following experiments 8, Experiment must be done by the students in this semester**

1. To study following techniques through photographs
  - a) Southern Blotting
  - b) Northern Blotting
  - c) Western Blotting
  - d) DNA Sequencing (Sanger's Method)
  - e) PCR
  - f) DNA fingerprinting
1. Project report on animal cell culture
2. To determine pH, Cl, SO<sub>4</sub>, NO<sub>3</sub> in soil and water samples from different locations
3. Microbial analysis in Water
4. To learn graphical representations of statistical data with the help of computers (e.g. MS Excel).
5. Basic idea about synopsis writing, review paper writing and thesis writing
6. Basic knowledge of statical software
7. Estimation of significance between samples using Student's t-test, F-test and Chi-square test.
8. Determination of MCV, MCH, MCHC and colour Index of the given sample of blood.
9. Determination of the urea in urine
10. Determination of the glucose in urine
11. Radiation uptake in various tissues: elementary idea of using radioactivity detection instruments.
12. Study of digestive enzymes in different parts of the alimentary canal.
13. Visit to Local Polluted Site -Observations and Remedial Measures
14. Practical Training& dissertation

